CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

18EC43

Fourth Semester B.E. Degree Examination, Feb./Mar.2022
Control Systems

Time: 3 hrs.   Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Distinguish between open loop and closed loop systems. **(04 Marks)**

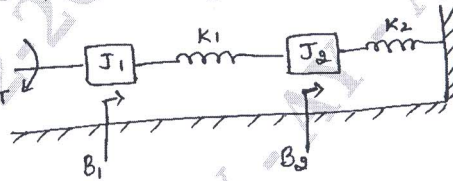b. Find the transfer function $\theta_2(s)/T(s)$ for the given mechanical system. **(08 Marks)**

Fig. Q1 (b)

c. Draw the F-V analogous circuits for the mechanical system shown in Fig. Q1 (c) with necessary equations. **(08 Marks)**
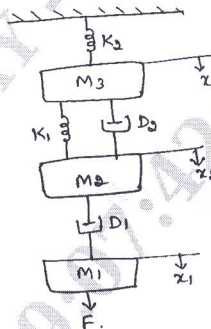

Fig. Q1 (c)

OR

2 a. Obtain the transfer function $X_1(s)/F(s)$ for the mechanical system shown in Fig. Q2 (a).
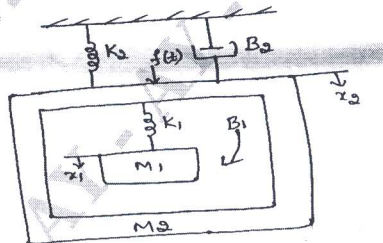

Fig. Q2 (a) **(10 Marks)**

b. Draw the T-I analogous circuits for the mechanical system shown in Fig.Q2 (b) with necessary equations.
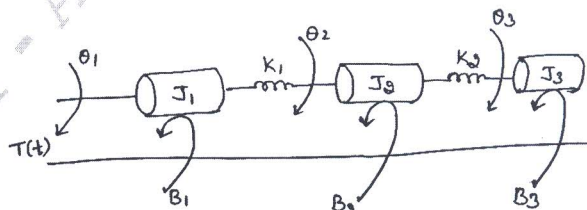

Fig. Q2 (b) **(10 Marks)**

1 of 4

Module-2

3 a. Obtain the transfer function of the system shown in Fig. Q3 (a) using block diagram reduction technique. **(10 Marks)**
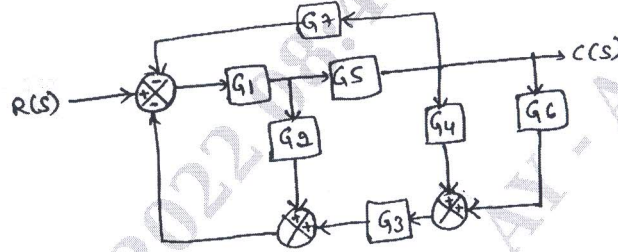

Fig. Q3 (a)

b. Draw the corresponding SFG for the block diagram shown in Fig. Q3 (b) and obtain the transfer function using Mason's gain formula. **(10 Marks)**
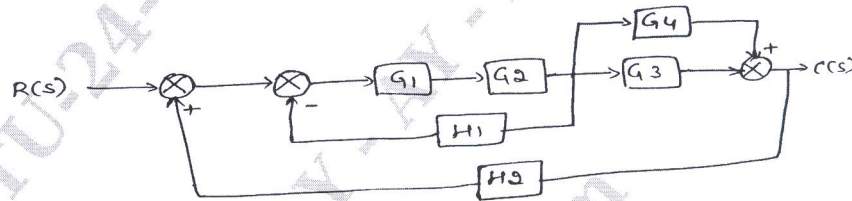

Fig. Q3 (b)

OR

4 a. Draw the corresponding block diagram, for the signal flow graph shown in Fig. Q4 (a). Obtain the transfer function, $T(s) = C(s)/R(s)$ of the system using block diagram reduction technique. **(10 Marks)**
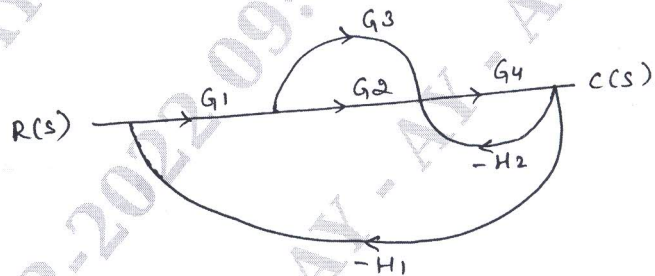

Fig. Q4 (a)

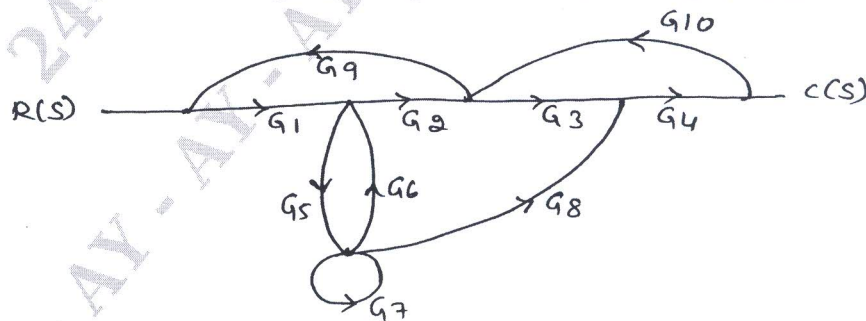b. Obtain the transfer function using Mason's gain formula. (Refer Fig. Q4 (b)) **(10 Marks)**

Fig. Q4 (b)

Module-3

5 a. Obtain the time response of a second order system subjected to unit step input for under damped condition. **(10 Marks)**

   b. A unity feedback system is characterized by open loop transfer function, $G(s) = \dfrac{K}{s(s+10)}$.

   Find the value of K so that the system will have a damping ratio of 0.5. For this value of K, determine the settling time, peak over shoot and time to peak over shoot for unit step input. **(10 Marks)**

OR

6 a. Derive an expression for peak time t_p and maximum overshoot M_P of an underdamping second order system, subjected to step input. **(10 Marks)**

   b. Find the position, velocity and acceleration error constant for a control system having open loop transfer function,

   $$G(s) = \dfrac{100}{s^2(s+2)(s+5)}$$

   Also determine the steady state error when the input is $r(t) = 1 + t + 6t^2$ **(10 Marks)**

Module-4

7 a. Define Routh Hurwitz criterion. Describe the necessary conditions for stability with special case. **(08 Marks)**

   b. The open loop transfer function of a C.S is given by $G(s) = \dfrac{K}{s(s+1)(s+2)(s+3)}$. Sketch the complete root locus. Find the critical value of K and location of roots on jw axis. **(12 Marks)**

OR

8 a. For a system with characteristic equation $s^5 + 2s^4 + 3s^3 + 6s^2 + 2s + 1 = 0$. Comment on stability using R-H criterion. **(06 Marks)**

   b. Sketch the Bode plot for the system having $G(s) = \dfrac{4}{(0.1s+1)^2(0.01s+1)}$.

   Find : (i) Gain margin   (ii) Phase margin   (iii) Gain cross over frequency
   (iv) Phase cross over frequency **(14 Marks)**

Module-5

9 a. Obtain the state model of the given electrical system. (Refer Fig. Q9 (a)) **(10 Marks)**
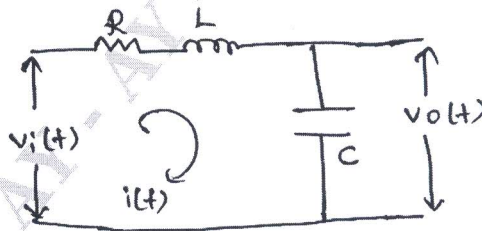

Fig. Q9 (a)

   b. Find the state transition matrix for $A = \begin{bmatrix} 0 & -1 \\ 2 & -3 \end{bmatrix}$. **(10 Marks)**

OR

10 a. Define state transition matrix and list its properties. (06 Marks)
    b. State and explain Nyquist criterion. (06 Marks)
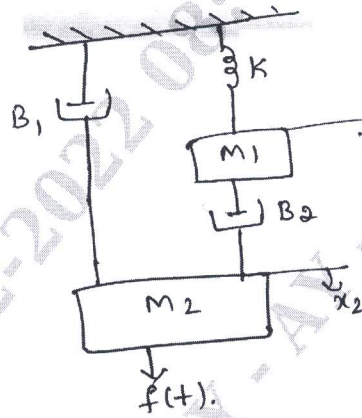   c. Obtain state model for the given mechanical system (Refer Fig. Q10 (c)). (08 Marks)

Fig. Q10 (c)

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